

ANTHONY REEVE WOODHILL, 1900-1965

(*Memorial Series No. 21*)

(With Portrait, Plate xviii)

With considerable pleasure, and without misgivings, we accepted the invitation to prepare a Memorial Notice in honour of the late Anthony Reeve Woodhill, for long a member, council member, and also a past President of the Linnean Society of New South Wales.

As time went on and we thought more deeply into this task, we found it easy to give a facile appreciation of our late teacher and friend and much more difficult to put the convictions we felt into the usual words used on such occasions. Our difficulties lay in the fact that Woodhill was not a flamboyant character about whom an endless string of anecdotes could be related, nor was he a spectacular teacher from whose lectures inspiring passages could be quoted, nor was he a controversial figure arousing the ire of some and the acclamation of others.

A. R. Woodhill had no airs or poses, he sought no favours for himself, there was no striving to impress. On these counts he might have been regarded as a colourless personality, but his personal appearance and austere reserve would dispel any such judgement on first meeting. Woodhill's students usually accepted him as a man standing on his own, essentially complete and independent, with no known ties and no need for such ties. When a man is accepted in this way it usually indicates a strength of character and individualism, and those who had close associations with Woodhill soon learned that he was indeed such a man.

There is no doubt that Woodhill was a strong character but perhaps not in the usual usage of this phrase. His strength lay in the complete and unswerving consistency of his thoughts and deeds; this was certainly the case in the thirty years we knew him, and for fifteen years beyond that to some of our colleagues who knew him from the time he entered the University of Sydney as an undergraduate.

We might have left it at this and enlarged on his contributions to our Society, but as we thought and recollected, and fitted Woodhill into the pattern of entomological development and achievement in Australia during this century, we wondered, as have others, whether Woodhill was accidentally in the hub of this development or whether he personally played any important roles. He did not, as others in related disciplines of biology were able to do, persuade governments that this or that action should be taken, he did not campaign for particular things to be done, nor did he seek, or attract, finance to sponsor his own researches or develop his department. Yet he did give New South Wales, and Australia, many of the entomologists it needed in the 1930's to early 1950's. Was this inevitable? Would it have happened no matter who was the teacher? Or did Woodhill make a personal contribution through his students?

To answer all this we must endeavour to understand Woodhill. What was his strength? What was his contribution?

We have said that students accepted Woodhill as an independent individual. Yet he had family ties and traditions; these he must have accepted since he remained true to them throughout his life. Woodhill was a member of an English family whose records go back to about 1670. There must have been a sense of family pride, of tradition and of unity, which infused into Anthony Woodhill throughout his youth. As far as we can glean he must have accepted this as part of himself for he never mentioned it, not even the fact that the village of Woodhill, near Nowra, derived its name from his family.

His grandfather, Alfred Meredith Woodhill, was born in Birmingham, England, in 1835 and later migrated to Australia where he weathered a series of vicissitudes of fortune before he became established as a successful country merchant.

He placed on record the history of the Woodhill family in "The Woodhill Family Record" published June 2nd, 1905, by F. H. Booth, Sydney. The family copy we have seen has been kept up to the present date, as was intended, by various members of the family. In it appears the family genealogy, and an account of the fortunes of Alfred Meredith Woodhill in his endeavours to succeed in his adopted country. The family was traditionally English, royalist and conservative. This flowed with undiminished vigour to Anthony Woodhill whose loyalty to King and Queen was unswerving throughout his lifetime.

There was also a tradition of service, again best expressed by the grandfather, who published

The Hawkesbury and Shoalhaven
Calendar,
Cultural and Cookery Guide
and
Useful Household Compendium

With Some Sketches of Pioneer Residents and
Notes on Early Settlement

(Illustrated)

Presented by
Woodhill & Co., The Universal Providers,
To the People of
Richmond, Windsor, Kurrajong, Nowra,
Berry, Cambewarra, Kangaroo Valley
and Surrounding Districts

1905

Printed for the Publishers by
THE WOODHILL PRINTING WORKS
127 York Street, Sydney

This book of 128 pages, plus a 64 page Cookery Guide, was certainly a handsome Christmas present for the customers of Woodhill & Co. and merited the following review in the Sydney Mail, Nov. 30, 1904. "The Woodhill Printing Works, Sydney, forwards 'The Hawkesbury and Shoalhaven Directory', a compilation dealing with two of the most interesting districts of the State, for which Mr. A. M. Woodhill is responsible. It is at once calendar, diary, 'cultural, and cookery guide', and compendium of information regarding old settlers of the Hawkesbury and the Shoalhaven. And its value is increased by numerous portraits and illustrations of stock and of the beauty spots of the district. Mr. Woodhill's book reflects credit upon his industry, and should be of value, and the idea of preparing and presenting it to the friends of the firms branches at Richmond and Nowra was a happy one".

Grandfather Woodhill was not only a merchant; he was interested in the people who gave service to the community, in the country itself and the means by which his customers earned their livings.

We have mentioned A. R. Woodhill's inheritance of a traditionally English conservative outlook, we can also suggest that a tradition of service to the community (not in the present day manner, but in a deeper and far less conspicuous way), an interest in the country, and in enlightened farming, may also have been part of this inheritance. But inheritance is seldom complete and no vestige of a merchant tradition ever reached him.

Grandfather Woodhill married Jane Kidd, born in 1836 at Launceston, Tasmania. They had seven sons and two daughters. Of these Alfred Robert Woodhill (born 1860) was Anthony's father. His mother was born Agnes Mary Pepper (1866, Richmond, Victoria). Anthony was their youngest child (born 1900) there being two others, Judith Gertrude (born 1890) and Geoffrey Guy (born 1895).

At the time of Anthony's birth his family was at Nowra, but owing to the ill-health of his father they moved to Wentworth Falls where his father recovered and lived to the age of 73. With his elder brother Geoffrey, of whom he was very fond, Anthony used to walk about the mountains and valleys, and for the rest of his life he had a special liking for the Grose Valley which he used to revisit to camp and fish even after his return from World War II.

Anthony was educated at the Woodford Academy on the Blue Mountains and his early ambition was to go on the land. On leaving school he spent two years at the Wagga Experiment Farm. However, family finances made this ambition impracticable so he came to the University of Sydney to do the course in Agriculture, entering the faculty in 1920 and graduating on 29th May, 1924.

His fellow students throughout this course were Charles Magee recently retired Chief of the Division of Biological Services, New South Wales Department of Agriculture, Professor J. R. A. McMillan recently retired Dean and Head of the Faculty of Agriculture at Sydney University, and M. L. G. Sheldon, now Deputy Principal of the Sydney Teachers' College.

From the time A. R. Woodhill graduated he was an entomologist, and at this point we have to pause to review the past history of the teaching and practice of this discipline and the changes that were commencing to take place and which continued with increasing tempo throughout most of Woodhill's professional career.

The Faculty of Agriculture had commenced operation in 1910, but none of the students of the first ten years emerged as practising entomologists. W. W. Froggatt, then Government entomologist in the New South Wales Department of Agriculture, taught the entomology course from the inception of the Faculty up to 1921. He is chiefly remembered, as was often recounted by Woodhill, for introducing insects as "bitin', chewin', or suckin'" as they went "hoppin', skippin' or jumpin' about" (he is also remembered for a vast series of publications on entomology).

Woodhill took Froggatt's course, but from 1922 onwards the course in entomology was given by A. J. Nicholson who later became Deputy Chief, later Chief, of the Division of Economic Entomology, CSIR (now Division of Entomology, CSIRO). However, Woodhill also took Nicholson's course during 1923. His fellow students remember that he was intensely interested in insects and perhaps gave more time to entomology than was wise. On graduation Woodhill entered the Department of Agriculture as entomologist, being the first graduate entomologist to be so appointed. His immediate chief, as Government Entomologist was W. B. Gurney who, originally appointed to assist W. W. Froggatt in 1900, succeeded him in 1923. Gurney graduated in Science in 1925, the year after Woodhill's appointment.

W. W. Froggatt (appointed Government Entomologist in 1896) was the first official entomologist in New South Wales and, up to the time of Woodhill's appointment, both Froggatt and Gurney had published much on the insect pests of this State. However, the problems were treated largely empirically, and it was only about the time of Woodhill's entry to the department that the empirical approach was being superseded by investigation into the bionomics of individual pests. Woodhill, and others who joined the department shortly after (Allman in 1925, then Hely and Morgan in 1926 and Noble in 1928) were all involved in detailed investigations of the life histories, host relationships and seasonal influences of particular pests. Much of this work was done in exacting detail but little of it was published—only the details that had practical application in primary industry. This was traditional during this period. For one thing the only medium of publication was the *Agricultural Gazette of N.S.W.* and, although it was accepted in principle that the complete work might appear in a special bulletin, this was seldom achieved since once one problem had been solved for the time being there would be another one demanding investigation. This may well have had an influence on Woodhill's later career, in his concentration on one problem at a time and in his modest statements of his own achievements.

Woodhill worked on blowflies with Gurney, on Dicky Rice Weevil with Allman, on the Woolly Aphid, the Green Peach Aphid, Citrus Red Scale and the Fruit Tree Root Weevil. Zeck who had been appointed to the Entomology Branch in 1923 studied the life history of the Green Peach Aphid, and from this Woodhill developed the idea of a bud swell spray for stem mothers followed by an attack on the eggs. Woodhill did a lot of research on the bionomics of the Citrus Red Scale, but this was never published, partly because as a multivoltine species it was not as amenable to control as a univoltine species such as the White Wax Scale.

Forty years later it is difficult to separate the work of Woodhill, Allman and Hely during this period, nor does it particularly matter. This was the period when control recommendations were being based on careful and detailed observations. The profound influence this approach had on Woodhill's later teaching was shown by the great emphasis he placed on what was then popularly termed "the bionomics of the species".

This then was the atmosphere of the time; but what of the man himself? He was undoubtedly handsome, over six feet tall, straight and with a natural dignity. His walk never varied and has best been described as a nonchalant saunter. He had become known as the "Count" during his undergraduate days and this cognomen remained with him. His hair was cut short and frequently. In those days he wore the very respectable black Indiana socks, smoked Chesterfield cigarettes and always carried an umbrella, or at least that is the impression that remains with his colleagues of this period. He always wore a hat but kept the brim turned up right around. Yet this picture is in part misleading since he was then, and remained until well into his fifties, an active and skilful tennis player. His service is well remembered for the extreme height to which he tossed the ball.

After six years in the Department of Agriculture he succeeded A. J. Nicholson as McCaughey Lecturer in Entomology at the University of Sydney.

Nicholson, a graduate of the University of Birmingham, had developed an excellent course in entomology for students of Zoology in the Faculty of Science and also for the Faculty of Agriculture. In Nicholson's words "the basis of both courses was general systematics, morphology, and general biology. Only sufficient of this was given to Agriculture students to provide a firm basis for an intelligent development of the subject of economic entomology, to which I naturally had to devote as much time as I could. With Science students I made little more than passing reference to insect pests and their control, treating entomology simply as a component of Zoology and going into greater detail with morphology, systematics and biology".

At this time the only avenue of employment for entomologists in New South Wales was the Department of Agriculture; similar organisations existed in other States. It was not until the CSIR Division of Economic Entomology was formed in 1928 that the Commonwealth itself provided employment for entomologists. This is historically important and is the reason why the best of Nicholson's students (e.g. Allman, Hely, Morgan, Noble and McCulloch) entered the State department. One or two others went elsewhere, e.g., O'Connor. Nicholson taught relatively few students in the Faculty of Science, entomology being the alternative to two terms of Vertebrate Zoology. During Nicholson's tenure, there were only three students in Science who became entomologists; these were Mary Fuller, K. E. W. Salter and C. E. Chadwick.

Nicholson's course, according to the University calendar of the time, comprised 40 lectures and a minimum of 120 hours practical. His main contributions to the teaching of entomology were the design of a sound basic course, the building up of an extensive and very representative systematic collection of insects for teaching, a considerable amount of which still survives, and the institution of field collecting with students.

When Nicholson resigned, the Dean of the Faculty of Agriculture, then Professor R. D. Watt (later Sir Robert) wished to have a lecturer in entomology appointed in the Faculty¹ but the wishes of the Professor of Zoology, then Professor W. J. Dakin, to have both branches of Entomology combined in the Department of Zoology prevailed. When appointed, Woodhill taught the subject known as Economic Entomology to a combined class of Science and Agriculture students.

The change was a little more profound, in that an honours course in entomology which had not been available during Nicholson's tenure was now instituted. This meant that the basic course could be followed by a year of specialisation in the subject, and was of great benefit to the students Woodhill trained to become practising entomologists.

It is unlikely that Woodhill would have changed Nicholson's course in any major way in the early years of his teaching, nor indeed is it likely that there was any need for this. However, Woodhill started teaching at the beginning of the era of insect physiology, and the subject went through a period of vast expansion and development lasting most of his teaching life so that changes were eventually inevitable. Nevertheless, entomology has a broad basis which needs to be learnt by all who practice the discipline and this remained in essence, if not in detail, throughout both the Nicholson and Woodhill periods.

However, Woodhill came from a position as a field investigator to a University Laboratory. He could no longer pursue studies of orchard pests although it was obvious that this was his initial intention—witness the two citrus trees which were planted outside the Entomology building and the Fruit Tree Root Weevil cultures which survived in jars for a year or so. He must have decided that, to continue research, and this he did for the greater part of his teaching career, a type of insect suitable for continuous laboratory culture and experimentation would be necessary. He chose mosquitoes and for some reason no longer known² he was intrigued by a particular species restricted in its breeding to saline rock pools on the seashore (then *Aedes concolor*, now *Aedes australis*). This was in the beginning of the 1930's when overseas mosquito investigations were directed to studies of the physical and chemical properties of water likely to stimulate or inhibit the breeding of individual species. Instead of investigating

¹ It was not until 36 years later (1966) that a lecturer in entomology was appointed in the Faculty of Agriculture.

² Miss Isobel Bennett has since informed us that the investigation was suggested by Professor W. J. Dakin who had become fascinated by the ability of this mosquito to exploit exposed rock pools on the sea shore, sometimes filled by rain and at others by seaspray, and sometimes encrusted with salt crystals.

the properties of natural waters Woodhill established laboratory cultures in a series of artificially varied water types. The results were probably a surprise to him. They indicated that the properties of the water were not likely to be the factors determining successful or unsuccessful breeding. He then turned his attention in a similar way to another laboratory species, *Culex fatigans*, and his results were similar in character in so far as larval development was concerned. Still he persisted and introduced *Aedes aegypti* to his experimental waters, adding more and more weight of evidence to the conclusions which, these days, we would regard as almost axiomatic.

Woodhill's work of this period was proof against, where elsewhere there was only dissatisfaction with, the then prevailing ideas of breeding requirements for individual species. Some of his students added to the weight of evidence (D. J. Lee with *Aedes vigilax*, R. H. Wharton with *Aedes aegypti*), but their results were never published. Woodhill started a chain of investigation which continued through several of his students to culminate eventually in the work of A. K. O'Gower who demonstrated the selectivity of the female for particular types of surfaces on which to oviposit. This was a definitive proof of the gradually and widely forming concept that the situations in which a particular mosquito species were to be found breeding were due to the selection of these places for oviposition by the female. In the meantime M. M. H. Wallace had made an important observation, confirmed experimentally by Wharton, of the oviposition requirements of *Aedes notoscriptus*. These are minor points, but their importance lies in the fact that Woodhill initiated a school of mosquito research from which important information emerged over a considerable period of years.

To the students who observed Woodhill undertaking his researches there was salutary example in particular and some stimulation as well. He was meticulous to a degree. He was also imbued with the recently developed ideas of statistically designed field trials and applied the same principles to his laboratory studies. He insisted on replicated experiments and he took into account the possible variables he could detect. He did the work personally, not because of mistrust for others, but because he had the conviction that his responsibility for the results obtained commenced with the inception of the experiment and continued throughout its duration. This was teaching by example and was perhaps the most important means whereby a heritage of scientific integrity and an insistence on a more than adequate weight of evidence was passed to his students.

Who were these students of this period 1930-1938? There were of course far more than in the time of Nicholson due to the natural growth of the undergraduate body, but there was also a growing demand for entomologists due, to some extent, to the State Departments expanding, but under the limitations imposed by the depression, and more particularly to the Commonwealth forming the CSIR Division of Economic Entomology in 1928. Many students in the Faculty of Agriculture took Woodhill's course but few majored in Entomology. For the first time a significant number of Science students specialised in Entomology, most of whom took the additional fourth year Honours course.

In 1931¹ F. J. Gay graduated in Science and was the first of Woodhill's students to gain first class Honours and to join CSIR where he remains to this day. J. A. Wright (1932), from Agriculture, went to the State Department first and later joined the old established pest control firm of Houghton & Byrne, eventually to become a director. G. S. Dun (1933), also from Agriculture, went to the New Guinea Service where he remained to retire as principal entomologist in 1967. R. V. Fyffe an Agriculture graduate of 1934 entered CSIR. In 1934 also H. F. C. Davis, with double Honours in Entomology and Botany, eventually initiated the teaching of Zoology in New England University College (now the University

¹ From here on the year given is that of completion of the course, not the year in which the degree was confirmed.

of New England). D. J. Lee (1935) was next from Science and went initially to CSIR, then to the Department of Agriculture and Stock, Queensland, and later to the University of Sydney and later became Associate Professor in Medical Entomology at the School of Public Health and Tropical Medicine, University of Sydney. D. Gilmour, graduating in 1936, remained at the University of Sydney for a time, then went to Harvard on a James King of Irrawang scholarship and eventually entered CSIR in 1941 to which organization he still belongs. Perhaps the best of all years was 1937, with three honours graduates in Science, D. Margaret Cumpston who later taught in the New England University College and later still did entomological research on malaria vectors in New Guinea; D. F. Waterhouse who went to CSIR to eventually become Chief of the Division of Entomology, succeeding Nicholson; and M. F. Day who initially joined CSIR but shortly went to America for several years to finally rejoin CSIR and was later appointed a member of the executive of that organisation. In 1938 K. L. Taylor, from Agriculture, went to the Forestry Department of N.S.W. but later joined CSIRO where he remains.

Later students who pursued an entomological career were L. R. Clark (1938), now in CSIRO; N. C. Lloyd (1939) of the N.S.W. Department of Agriculture; G. Pasfield (1940), now Chief Entomologist, Division of Science Services, N.S.W. Department of Agriculture; G. J. Shanahan (1941), now Senior Entomologist in the same organisation; D. H. Colless (1942) delayed his honours course until after military service, then undertook malaria research in Borneo, later went to University of Malaya and finally joined CSIRO; R. H. Wharton (1942), originally a student of H. F. C. Davis at New England, did his honours at Sydney under the guidance of Lee, worked on malaria and filariasis in Malaya for fifteen years and has recently become officer-in-Charge, Entomological Investigations, CSIRO Veterinary Research Station, Yeerongpilly; M. M. H. Wallace (1942), also under the guidance of Lee, entered CSIRO where he remains; J. G. Gellatley (1947), B. M. Braithwaite (1948) and E. L. Jones (1948) are in the N.S.W. Department of Agriculture; A. K. O'Gower (1948), originally an entomologist at the School of Public Health and Tropical Medicine, is now Associate Professor in Zoology at the University of New South Wales; E. Shipp (1949), is now Senior Lecturer in Entomology at the University of New South Wales; J. H. Burden (1949), now teaches Entomology at Hawkesbury Agricultural College; R. G. Lukins (1949) is with CSIRO; A. L. Dyce (1950) joined CSIRO where he remains; L. B. Barton-Browne (1950) again is an officer of CSIRO; W. E. Wright (1950) is in the N.S.W. Department of Agriculture; B. Johnson (1951) originally went to the Waite Institute but is now Professor of Zoology at the University of Tasmania. Between 1952 and 1957 the following professional entomologists graduated from the Zoology Department and joined the institutions listed: M. A. Bateman, 1952 (CSIRO); M. Casimir, 1952 (New South Wales Department of Agriculture); T. D. C. Grace, 1953 (CSIRO); E. M. Reed, 1957 (CSIRO); T. V. Bourke, 1957 (N.S.W. Department of Agriculture).

There were, of course, later students, but from this time there was a reduction in the time available for the entomology course and Woodhill was not able to give the same solid grounding in the subject.

Those who benefited most from Woodhill's course were those who took his first course and followed this by sitting for Honours in Entomology in the succeeding year. In these two years the method of approach was quite different.

In the formal pass course Woodhill's success lay in his careful preparation of lecture and practical courses. "Careful" must be emphasized for what he lacked in colourful presentation was more than counterbalanced by his unfaltering delivery of all the information he imparted with professional dignity. He just never stumbled, never forgot a detail nor omitted a pertinent fact. The course

itself, as Nicholson's must have done, drew heavily on Imms' "Textbook of Entomology" since this was such an excellent source book on basic entomology. Woodhill added enough of the recent advances in the subject to arouse the interest of students, and also a survey of the more important pests of New South Wales, drawing heavily on the researches of his former colleagues in the State Department.

The result of this was a very solid basis to entomology, both pure and applied, upon which his students could build with confidence either in research or in applied fields.

Woodhill's personal influence was greatest in his Honours course. In this he did not teach but provided guidance and example. Teaching and students dominated his professional life, research he pursued during vacations although some would also be underway in term time. Yet he was always available to his students with never more than an hour or two delay.

The organisation of his department was austere but efficient. His collection of books, selected journals and fairly extensive reprints, together with important specimens of all major groups of insects, were housed in one room. There was seldom a student question which could not be answered within that room.

By the time his students had entered their honours year they were usually capable of selecting their own research project. Woodhill allowed a great deal of freedom of choice, although he did give guidance on what he considered would or would not merit an Honours degree. He was not over concerned with a successful conclusion of the project, possibly because some of his own early work had had no satisfactory outcome. His assessments were based on observation of the student's ability to handle and develop his project. Guidance was given when asked for but the student definitely had to establish his ability to stand on his own feet. The project was not all; students were thoroughly grounded in the use of literature sources, there were more advanced exercises in anatomical dissection of insects, microtomy, and anything else the student might desire to do, and perhaps the most important of this miscellany, identification in most orders by means of keys. Woodhill stressed the use of keys and insisted that his students should be able to use the best of those available. He was also adamant that there should be complete absence of ambiguity in keys prepared by his students or colleagues.

One important point has so far been overlooked. From the time of Lee it became common practice to combine senior Zoology with Physiology (then a combined course of Physiology and Biochemistry). This was out of Woodhill's field, but in keeping with the overseas trends of that period—notably the developing emphasis on insect physiology. Inevitably some of his students became interested in the investigation of physiological problems and Woodhill was pleased to have students tackling problems for which he himself lacked the basic training. Whether it was insect physiology or any other specialization in entomology there is no doubt that he derived great satisfaction from seeing the subject he taught being extended into new fields.

The essence of all this is really that Woodhill provided a very sound basic training in entomology from which could emerge any type of entomological specialisation suited to the individual student.

In his thinking Woodhill was conservative and at times inflexible, but in his dealings with students he could be convinced if the student was able to produce strong arguments—nay, more than that, real evidence. A student who could convince Woodhill had every reason to be confident in his ideas!

Woodhill had certain other attitudes to students. He did not actively seek to take advanced students, as he felt it was a violation of his trust to train more students than could reasonably hope to gain employment in a relatively small

field. He discouraged women students for he realised that they had no chance of employment in State departments and few prospects elsewhere if they continued with entomology.

Woodhill realised his need to know more of insect physiology, so in 1939 he took his only sabbatical leave to visit England and work with Wigglesworth. This visit was prematurely terminated because of the outbreak of World War II. He chafed to get home and enlist partly because of his strong feelings for the British Empire, and partly because he had lost his well-loved brother Geoffrey, killed at Poziers in 1916 during World War I.

On his return to Australia he found that because of manpower restrictions he would not be able to enlist as a private but had to wait until 1941 when he was accepted as a commissioned officer.

While a member of the armed services he undertook teaching and research activities, mostly on mosquitoes but at one point, and rather to his disgust, also on mites but this only briefly.

His first major task was to assist in the investigation of the 1942 outbreak of malaria in the civilian population of Cairns. Prior to this no vector had been incriminated for any part of the mainland of Australia. This was a particularly interesting and important exercise with most of those most competent to solve the problem present. G. M. Heydon and A. J. Bearup were there on the parasitological side, F. H. Taylor, Woodhill and F. H. S. Roberts on the entomological, with I. M. Mackerras and N. H. Fairley also present part of the time. The important entomological result was the identification of *Anopheles farauti* (then *An. punctulatus moluccensis*) as the vector at Cairns. This species had not previously been identified from Queensland, although later checks in collections showed that it had been previously collected but misidentified.

Despite published records to the contrary we are quite certain from our perusal of Army documents of that period, and from those present at the time, that the credit for this identification goes to Woodhill. Taylor, who was the recognised authority at that time would make no identifications other than of the two species known to occur (*annulipes* and *amicus*). Heydon cast doubt on some of these identifications, and the situation although probably rather bitter at that time, is amusing in retrospect. It is easy to imagine Woodhill, using keys and the scanty literature available, ploughing doggedly towards an identification at variance with the categorical determination of the expert. Woodhill had no time for unsubstantiated opinions, he would have insisted on verification, almost scale by scale. Heydon's personal diaries are interesting for this period. He was apparently convinced all the time, from his considerable experience in Rabaul, that the culprit was indeed *An. farauti* as he referred to it throughout his diaries for this period by the then current name *moluccensis*. However, probably from professional loyalty to his fellow worker, Taylor, he made no such reference in his official correspondence.

At this point Woodhill embarked on a study of a section of the genus *Anopheles*, for which he undertook extensive field work in the Northern Territory, followed by laboratory studies at the University of Sydney and in the field in New Guinea, much of this being done in collaboration with Lee working at the University of Sydney.

Woodhill was not a systematic entomologist and would probably never have embarked on any systematics if it had not become necessary in the course of his Army duties. Nevertheless, he was quite capable of solving taxonomic problems. He did this, not by recognising a species intuitively, but by meticulous attention to detail and the exacting examination of precisely the same features in hundreds, and later thousands, of individual specimens. He never let himself be unduly influenced by the work of others and in the course of this work gave a salutary demonstration of the real value of his approach. Woodhill collected a species in the Northern Territory which he was unable to identify. Lee who had been

studying exotic species was able to make a positive identification of *Anopheles novaguinensis* from the original description. Woodhill later studied this species in Sydney and discovered a most striking character by which this species could be identified. This had been overlooked in the original description and had passed unnoticed by Lee.

Woodhill was in Salamaua during May-July 1944. While there he concentrated on the *Anopheles punctulatus* complex trying to resolve the status of the frequently observed morphological intermediates between what were then known as *Anopheles punctulatus punctulatus* and *Anopheles punctulatus moluccensis* (now *An. punctulatus* and *An. farauti*). This study was published (Woodhill, 1946) and the original hypothesis of Lee and Woodhill (1944), that these intermediate forms were a result of hybridization, while not confirmed, was strongly supported by the evidence obtained.¹

Woodhill's findings at Salamaua were conservatively stated in his 1946 paper. Here he presented the observations he considered clinched the hypothesis that intermediate forms were hybrid in origin. Much of his labour went unrecorded. He does not mention for example that he bred 15,000 adults from larvae collected in a particular area to establish the purity of the *An. punctulatus* population at this locality. This, and other evidence, usually massive and never trivial, he outlined in correspondence to D. J. Lee.

The above is an example of Woodhill's insistence, in his own work, on an overwhelming weight of evidence. This did not fail to make its impression on his students even though they may have considered it as scientific integrity carried to the extreme.

Was this insistence on weight of evidence, followed by a modest presentation of results, an inherent part of Woodhill's individuality? Certainly it was in keeping with his character but it was also a likely result of his training in the New South Wales Department of Agriculture, possibly due to the influence of Gurney, but possibly simply a product of the circumstances of the times.

Woodhill considered his work on *Anopheles* was the best he had done and only he could fully realise the effort it cost him. Hence he decided to submit his research papers for a doctorate and was awarded a D.Sc. Agr. in 1951. To his students this was an occasion for celebration and all available former students, and their wives, gave Dr. and Mrs. Woodhill a congratulatory dinner at the Sydney University Union.

His finding of a new subspecies of *Aedes scutellaris* (*Ae. scutellaris katherinensis*) in the Northern Territory, together with his study of subspeciation in *Anopheles punctulatus* led him to embark, in the post-war years, on a further line of mosquito investigation, the crossing of related species and subspecies. This he proceeded to do with precisely the same attention to meticulous detail and incorporation of controls in his experiments as he had always used. Because of this he was more likely to be right than others who sometimes produced contrary results. In this work the organisation of his colonies was more exacting than before; a single mosquito placed in the wrong cage could produce false results and this worried Woodhill at times, hence his insistence on doing everything himself.

¹ This was despite the fact that a new species, *An. koliensis* Owen, had been described from the Solomon Islands, this species being indistinguishable from some of the presumed hybrid forms observed in New Guinea. To this day, despite a period of insistence on the separate specific identities of *punctulatus*, *farauti* and *koliensis*, the controversial issue has not been resolved to the satisfaction of all. Metselaar (1957) while adopting the three closely related taxa as species, as established by Belkin, Knight and Rozeboom (1945) also remarked on the preference for Australian workers to regard them as subspecies conceding that "the problem still awaits solution". Few would be adamant that one or other of the extreme views is the only answer. Probably both are correct but the circumstances under which either one obtains remains to be explained and no doubt complex problems of genetics and ecology are involved.

At the time this work was a contribution to the general body of knowledge on the cross-mating potentialities of closely related species, but one important finding was a peculiar kind of non-reciprocal fertility within the *Aedes scutellaris* complex (Woodhill, 1949, 1950, and Smith-White and Woodhill, 1954). One type of crossing resulted in normal fertility but its reciprocal was sterile. It was suggested that this sterility might be due to a factor in the cytoplasm of the egg of one species which is incompatible with the sperm of the other, killing the latter before karyogamy.

The dramatic success of the release of mass-reared males of the screw-worm fly, after irradiation to produce dominant lethal genes and other changes, has led to this technique being thought of as the ultimate in pest eradication. For mosquitoes it suffers the disadvantage of interfering with mating competitiveness and hence is not likely to be successful. Woodhill's sterility phenomenon is not an alternative to the use of irradiation to produce sterility or genetic death but a parallel technique with considerable chances of success, especially in the *Aedes scutellaris* complex with which Woodhill was working. The implications of this non-reciprocal fertility have recently been discussed by a WHO Scientific Group and reported in "Genetics of Vectors and Insecticide Resistance" (WHO Technical Report Series, no. 268, 1964, pp. 34-38).

After his return from Army service Woodhill unbent a little. He was still the well-dressed, well-groomed handsome man but the umbrella was not always present and the hat disappeared. To one of us he said "Dave, I came to realise that as I left home in the morning I picked up my hat, walked out the door, put on my hat, walked to the bus, got in the bus, took off my hat, got out of the bus, put on my hat and walked to the ferry, took off my hat, got off the ferry, put on my hat, walked to the tram, got in the tram, took off my hat, got out of the tram, put on my hat, walked down Science Road, entering the Zoology building and took off my hat, and when I realised this, I thought the hat was not really necessary".

Woodhill continued to teach entomology in much the same way in the post-war years but modified his course giving, for example, considerable attention to DDT in the early years of its usage. In 1952 we find that the University Calendar records the course in entomology as consisting of 50 lectures and 135 hours practical, an increase over the previous 20 years. Then came a dramatic reduction in 1953 to 20 lectures and 30 hours practical in the Faculty of Agriculture.

This reduction was a blow to Woodhill, especially since the subject had expanded enormously during his teaching career and several of his former students had already gained world reputations in entomological research. The effect of this blow to himself and his subject, together with the difficulties he had had over the previous two years in his candidature for a Readership, must have had their repercussions on his health and in 1956 he suffered a very severe heart attack from which he recovered slowly but never fully regained his former vigour. In this period he was also subject to periodic attacks of diverticulitis. He continued to teach, but with reducing force, up to the time of his retirement in 1965, and perhaps it was his sheer doggedness that kept him alive to this point as his death occurred some five months later.

One of the enigmas of Woodhill's tenure was the fact that his department never expanded when all other comparable sections did so, especially with the institution of Teaching Fellows. Woodhill certainly preferred to do everything himself, apart from the laboratory assistance given him by Miss Gwen Burns for much of the early teaching period, later by K. E. W. Salter and later still by J. Henry, his wartime staff sergeant. Whether he ever sought to expand and met with refusal, we do not know, but the fact remains that he never took one of his own graduates into his section. Knowing the man, we are inclined to think that he sought better things for his students and there is no doubt that he did all he possibly could, and much more than many of his colleagues, to place each

of his students. In this he was very fair and made an equal attempt to place the occasional student he was not very keen about as for those he considered had a bright future in entomological research or practice.

“Following his retirement, an appeal was made to his former students to establish an A. R. Woodhill Fund. It is hoped now to use this fund to endow an annual prize in Entomology or to establish some other fitting memorial to honour his memory” (L.C.B. in Union Recorder, September 8, 1965). This fund was finalised in 1966 and an annual prize established for Entomology in the Faculty of Agriculture.

Woodhill's professional career was separate from his family life so that there has so far been no suitable place to record his marriage, in 1926, to Gwyndoline Smith. Although taking no part in her husband's research or teaching activities Gwyn Woodhill provided him with a social life of mutual interest. She had also a long standing and active interest in the University of Sydney's traditional charity, the University Settlement. For this Mrs. Woodhill annually arranged a Chrysanthemum Tea and Tony gave much time to, and had much pleasure in bringing on their garden to look its very best for this occasion.

For the first twelve years of their married life they lived at Northwood and here their son Rodney was born. Later they moved to Hunters Hill, and with more leisure, found a congenial group of friends with whom they played tennis, bridge and in Tony's later years, bowls.

This then was Tony Woodhill, a man of the highest integrity who followed his chosen career throughout his adult life, a man who sought no favours nor entered into intrigues of any kind. He was a man who had a job to do, and did it faithfully and well. That job was not just the teaching of entomology, but rather was to supply Australia with promising young graduates in Science or Agriculture ready to embark on a rewarding career of entomological research. This was a need Australia had, and there is no doubt that the achievements of his students are a continuing reflection of the sound instruction and admirable example of their mentor.

D. J. LEE

D. F. WATERHOUSE

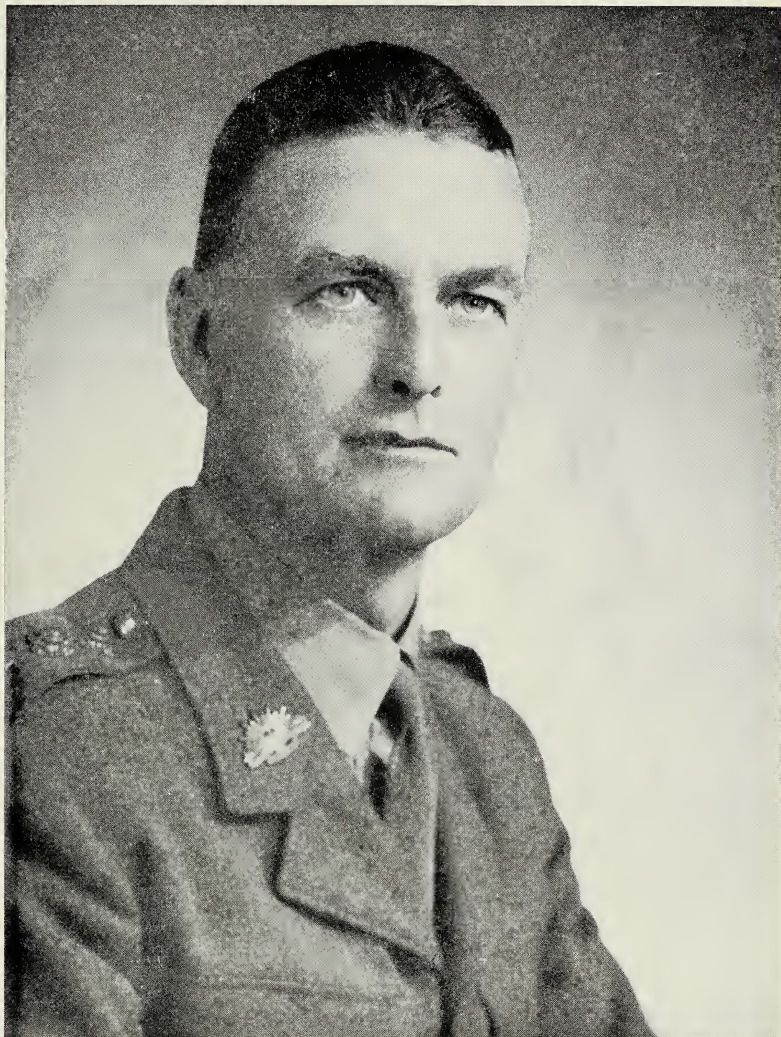
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A. R. Woodhill